MAB-227-M

INFORMAL STUDY
AND
RECOMMENDATIONS REGARDING
CORROSION

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National Research Council

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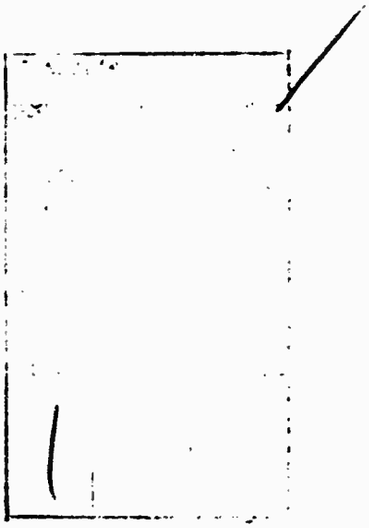

INFORMAL STUDY
AND
RECOMMENDATIONS REGARDING
CORROSION

Prepared by the
Materials Advisory Board
Division of Engineering - National Research Council

as a service of
The National Academy of Sciences
and
The National Academy of Engineering
to the
Office of Defense Research and Engineering
Department of Defense

National Research Council
National Academy of Sciences - National Academy of Engineering
Washington, D. C.
August 1966

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This report is a study undertaken by the Materials Advisory Board for the National Academy of Sciences in partial execution of work under Defense Supply Service Contract Number DA-49-083 OSA 313, between the Department of Defense and the National Academy of Sciences.

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ABSTRACT

A broad look was taken of the corrosion problem in order to recommend whether or not a deeper study by another committee was needed. There was agreement as to the unsatisfactory manner in which current corrosion problems are usually handled, and regarding the inadequate training of engineers.

The formation of a group to provide documentation on a number of specific items, which are listed, was strongly recommended. The topics requiring such study include a summary of the major corrosion problems, our capabilities for attacking corrosion problems, the effectiveness of present methods, and areas ripe for improvement in dealing with corrosion.

CONTENTS

CORROSION

At the request of the Materials Advisory Board a committee whose membership is shown on Page iii, met in Washington, D. C., on June 28, 1966, to discuss the handling of corrosion problems.[1] Also present at the meeting were several representatives from the Department of Defense, the Navy, the Army, and the C.I.A. The purpose of the meeting was the over-all examination of the corrosion problem in its broadest aspects and implications, in order to determine the merit and need for establishing another committee to examine this subject in greater depth. The assignment to survey the problem followed expressions of concern made by prominent corrosion experts directly to the National Academy of Sciences.

An assessment of the importance of corrosion problems was sought first, especially to the Department of Defense but also to the economy as a whole, through statements by and discussions with the guests present and from personal knowledge of the members of the committee. We concluded that corrosion represents a problem of enormous expense, great inconvenience, and considerable danger to human life. For illustration, consider corrosion problems encountered in military aircraft. Improved power plants and auxiliary equipment have forced radical design changes which involve the use of higher strength materials. The susceptibility of such materials to intergranular attack, stress corrosion cracking, and hydrogen embrittlement, coupled with the difficulty of adequate inspection, make corrosion protection mandatory. The dollar cost of such maintenance is enormous; great inconvenience is caused by the hours of maintenance required for each hour of flight time; and there is considerable risk to personnel should

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[1] Corrosion is here defined as "The Reaction of Metals with Their Environment".

protection fail. While the situation is "lived with" the present solutions are far from satisfactory. Not only is the effectiveness of present equipment and devices severely hampered by corrosion but also the development of improved devices and new equipment is increasingly limited by the threat of corrosion. Examples discussed included aircraft structures, aircraft and other gas turbines, deep sea vessels, high speed ships, and electronic equipment.

We discussed at length the way corrosion problems are dealt with today. The committee felt that its factual information about the field of corrosion was very inadequate so that in assessing the area we were forced to rely mainly on our general knowledge and experience. We felt strongly that considering the importance of the problem corrosion receives far less attention in educational institutes than it deserves. A result, and to some extent a cause, of this situation is that the field is not highly regarded by scientists and engineers--it lacks "glamour". A further result is that the best students in science and engineering are not attracted to the field, which means that outstanding people trained in corrosion are hard to find. Finally, the science underlying corrosion is in part neglected or inadequately performed. It was also our strong feeling that a thorough study would reveal that corrosion research has resulted directly in practical applications --some examples of such immediate results of research were reported by Dr. Sudbury.

With regard to the development of corrosion resistant materials and of methods for protection against corrosion we felt that while the performance of the United States is perhaps equal to that of other nations,

nevertheless our methods are to some extent haphazard, unsophisticated, and unsystematic. In some important instances solutions have been arrived at more or less by accident, and we cannot rely on chance alone to insure satisfactory future performance.

Many problems in the corrosion area are caused by difficulties in communication between science and applied engineering and between applied engineering and design engineering. The training in corrosion received by engineers is felt to be highly inadequate in many, if not most, instances. The books and handbooks available leave much to be desired.

The committee was unanimous in the belief that the present handling of current corrosion problems and the development of scientific knowledge on which to base future solutions is certainly not satisfactory. As a first step toward improving our capability it is our recommendation that a committee be established by the Materials Advisory Board or by some other appropriate agency to make a thorough study of the field of corrosion. The object of the committee should be to provide information on which an accurate assessment of the area of corrosion can be made to permit the development of plans for future action. Members of the committee should represent the wide variety of scientific disciplines on which the understanding of corrosion is based as well as the areas of corrosion protection and design engineering.

Specifically, we feel that the proposed committee should seek to provide documentation and answers to at least the following questions:

1. What are the major corrosion problems, and how do they affect performance?

A. Limitations on development

B. Loss of service of equipment.

C. Cost of corrosion prevention and maintenance to correct corrosion damage in relation to equipment cost.

D. Loss of human life.

E. Major technical problems, present and future.

2. What are our capabilities for attacking corrosion problems?

A. Survey of the people active in corrosion work with regard to type of work, training, experience.

B. Survey of the laboratories engaged in corrosion work

C. Survey of educational institutions in which corrosion is taught.

D. Survey of sources of corrosion information.

E. Survey of the level of corrosion knowledge, or at least formal training, among engineers not engaged directly in corrosion work.

F. Survey of opportunities to attack corrosion arising from advances in other fields of science.

3. How effective are our present methods?

A. Case histories of solutions to problems.

B. Document connection between research and application.

C. Comparison with experience in other nations.

D. How well can we predict corrosion behavior?

4. How could we improve our ability to deal with corrosion?

A. Teaching.

B. Research.

C. Dissemination of information.

D. Establishment of new institutions.

E. Establishment of new sources of funds for support.

In summary, the informal committee has a strong feeling that the current means and techniques of coping with corrosion problems is inadequate, and believes it to be of the utmost importance that a thorough study be made as suggested.

APPENDIX A

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Washington, D. C.
June 28, 1966

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DOCUMENT CONTROL DATA - R&D

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1 ORIGINATING ACTIVITY *(Corporate author)*

National Academy of Sciences-National Research Council
Materials Advisory Board, Washington, D. C. 20418

2a. REPORT SECURITY CLASSIFICATION

Unclassified

2b GROUP

3 REPORT TITLE

INFORMAL STUDY & RECOMMENDATIONS REGARDING CORROSION

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

5 AUTHOR(S) *(Last name, first name, initial)*

Informal Study Group on Corrosion, Materials Advisory Board

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
August 1966	10	

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
DA-49-083 OSA 313 Defense Supply Service b. PROJECT NO.	MAB-227-M
c. d.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

A broad look was taken of the corrosion problem in order to recommend whether or not a deeper study by another committee was needed. There was agreement as to the unsatisfactory manner in which current corrosion problems are usually handled, and regarding the inadequate training of engineers.

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DD FORM 1 JAN 64 1473

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14. KEY WORDS	LINK A		LINK B		LINK C	
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